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Mississippi Agricultural Experiment Station

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CONTROL OF DISEASES OF FRUITS,
VEGETABLES AND FLOWERS.

By H. C. THOMPSON.

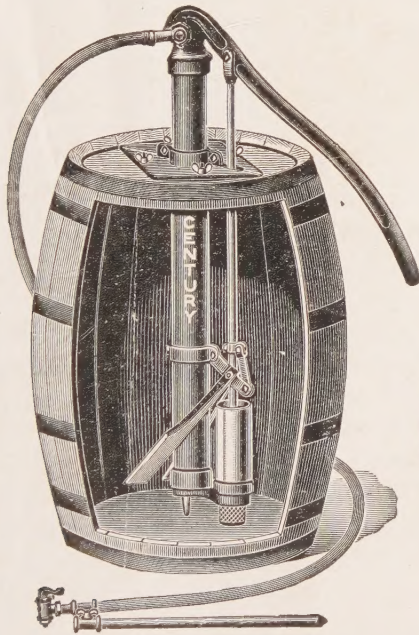


Fig. 1.—A good type of barrel pump with paddle agitator. This is the most economical kind to use for a small orchard or garden. (Deming.)

AGRICULTURAL COLLEGE, MISSISSIPPI.

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CONTROL OF DISEASES OF FRUITS, VEGETABLES AND FLOWERS.

Introduction.

This bulletin is written for the farmers, fruit growers and truck growers of Mississippi to answer the question as to how to successfully combat diseases. The attempt is not made to give remedies for all diseases of all our cultivated plants, but to give those of most economic importance. Considerable space is given to a discussion of apple diseases, not because the apple is an important crop, but with the hope that the cultivation may be extended to all parts of the state, especially for home use. Without proper protection from diseases, none of our common fruits will reach perfection and in some cases will amount to almost nothing.

The boll weevil will undoubtedly drive many cotton planters to growing other crops on the farm and the truck and fruit crops will come in for some recognition. Knowing that successful fruit or vegetable culture is dependent upon a rational system of protection against diseases, we hasten to answer the questions that will be asked. Fruits and vegetables cannot be grown satisfactorily without some knowledge of their enemies and methods of control. Spraying is the only practical way to keep these in check and some knowledge of this operation is absolutely essential. No phase of horticultural practice pays greater returns for money invested and none is more essential. The difference between spraying and not spraying means, in most cases, the difference between profit and loss. The work properly done at the right time often pays 500% on the cost of application.

Spraying has passed the experimental stage and is practiced by all up-to-date horticulturists. The fruit grower should know the common diseases and insects that affect his plants, should know their habits and life history, so as to know what treatment to use and at what stage in the life of the organism. Too much emphasis cannot be placed upon the necessity of doing the work at the right time with the proper solution and thoroughness of application. The most successful applications for diseases are made before the diseases appear because the remedies are preventatives rather than cures. The vegetative portion of the fungus producing the disease grows within the tissue of

the host plant and cannot be reached after it has obtained a foothold. Proper application of a fungicide will, however, prevent the spread of the disease to other plants. The best time to spray for diseases, therefore, is about the time the spores are ripening and being distributed.

Kinds of diseases.—There are two general classes of diseases. (1) Fungus diseases are those caused by the growth of fungi, which are small parasitic or saprophytic plants. (2) Bacterial diseases are those caused by the growth of bacteria. Under the first head are most of the common diseases, as the bitter rot, of the apple, brown rot of the peach and plum, apple rust, apple scab, potato scab, cucumber anthracnose and mildew, etc. These can be successfully kept in check by spraying. Under the second head, are such diseases as pear blight or fire blight of the apple and pear. This cannot be controlled by spraying because all of the growth is within the host plant.

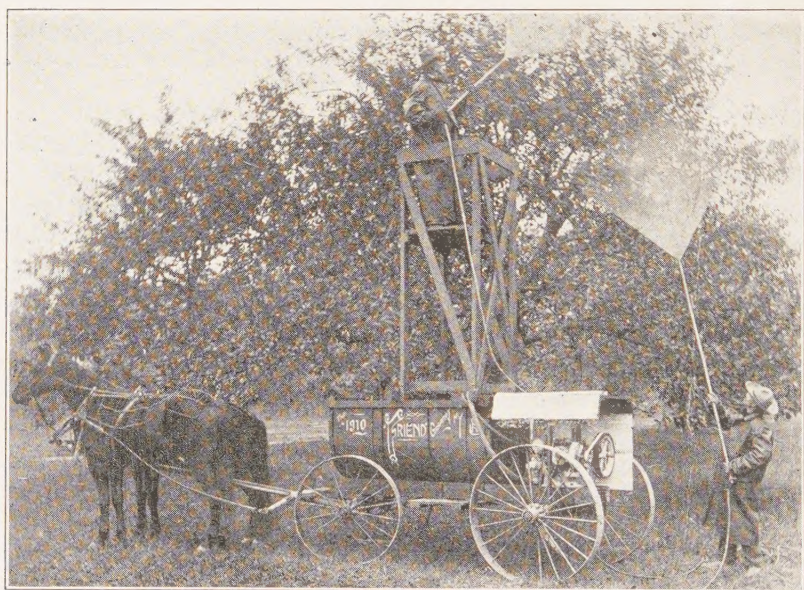


Fig. 2.—One of the best types of power sprayers, with all necessary appliances. (Friend Mfg. Co.)

Spray pumps and appliances.—There are all sizes of spray pumps on the market from the small hand or bucket pumps to the large power sprayers and the individual must decide for himself which one to buy. The author does not recommend anything smaller than the barrel pump for ordinary garden use. One similar to the one shown in Fig. I

is very satisfactory and can be secured from most any of the dealers mentioned in the list and the cost will not exceed \$25.00. For an orchard or garden of several acres, a power spray of some kind is most economical and one similar to the one shown in Fig. II is very satisfactory. These power sprayers give a uniform high pressure and better work can be done with them than with the smaller machines. The working parts of the pump should be of brass and the valves should be easily accessible.



Fig. 3.—Bamboo extension rod, light and convenient to handle. (E. C. Brown Co.)

The discharge hose should be at least 25 feet long and of best make. Nothing less than a four-ply hose is recommended because the high pressure bursts the cheaper hose. For spraying trees, an extension rod is necessary. The best rods are made of light brass fitted with light bamboo and should be about ten feet in length. See Fig. III. Small iron pipe is sometimes used but it is heavier than bamboo. The end of the hose where it connects with the extension rod should be provided with a stop cock to prevent waste of spray material when going from one tree to another, or when the nozzle gets clogged. One with one-quarter turn is best.

Nozzles.—No part of the spray outfit is any more important than the nozzle for upon them depends the economic and effective performance of the work. The object in spraying for fungus diseases is to thoroughly cover the surface with the least amount of liquid possible and this is secured by using nozzles which produce a fine spray. None have given greater satisfaction than the nozzles of the Vermorel type. In spraying for the coddling moth a coarser spray is better, for the object is to fill the calyx of the small apple with the poison. To secure this, a high pressure and nozzle which gives a coarse spray is best. The Bordeaux and Vermorel with the large opening in the cap are very satisfactory. Many of the nozzles have movable caps with various size openings. A large opening is from 1-16 inch to 1-10 inch, and a small from 1-32 inch to 1-24 inch. For most spraying a cluster of two or three nozzles is used on each hose, unless some of the larger nozzles are used. All of the manufacturers and dealers of spraying machinery and appliances have good nozzles of the various types and there are a good many new types on the market.

Spray mixtures.—Any mixture used for plant disease is called a fungicide and the active principle in most fungicides are copper and sulphur. Copper sulphate is the most common compound used and the mixture most generally employed is Bordeaux Mixture.

FORMULAE AND METHODS OF PREPARATION.

Standard Bordeaux, 4-4-50.

Copper Sulphate.....	4 lbs.
Lime (unslaked).....	4 lbs.
Water	50 gallons

This is used for all outdoor plants except peaches and plums when in leaf.

Weak Formula, Bordeaux, 2-2-50.

Copper sulphate.....	2 lbs.
Lime (unslaked).....	2 lbs.
Water	50 gallons

Used on peaches and plums when in leaf and on cucumbers in greenhouses.

The copper sulphate is dissolved in a wooden or stone vessel by suspending in a bag in the top of the water. After dissolving it is diluted to 25 gallons. The lime is slaked in another vessel and diluted to 25 gallons. The two liquids are poured together and stirred vigorously and strained into the spray tank so as to get out all particles which would clog the nozzles. To test the Bordeaux, use a clean steel blade knife; dip it into the liquid and if it comes out coated with copper, more lime should be added. If the blade comes out clean the mixture is properly made. Bordeaux should never be used when the fruit is ripening because it spots the fruit.

Ammonium copper carbonate.

Copper carbonate.....	5 oz.
Ammonia (about 26" Baume).....	3 pts.
Water	50 gallons

Dissolve the copper carbonate in the diluted ammonia. Just enough ammonia should be used to dissolve the copper carbonate. Dilute to 50 gallons. This is used when fruit is maturing in place of the Bordeaux mixture.

Copper sulphate solution.

Copper sulphate.....	2-2- $\frac{1}{2}$ lbs.
Water	50 gallons

Dissolve the copper sulphate and dilute to 50 gallons. Used on trees in a dormant condition as it would burn the foliage if applied when the trees were in active condition.

Formalin for potato scab.

Formalin (40% strength).....	1 pt.
Water	30 gallons

Soak potatoes in solution for two hours and pour out to dry. Bags of potatoes may be put in barrel containing mixture or the potatoes may be poured in and the mixture drawn off by a faucet into another vessel.

Sulphur.—Sulphur is used in the greenhouse for many diseases. It may be evaporated over a flame, but it must not burn or the flowers will be killed. The most common method is to make into a paste and smear on heating pipes.

Lime-sulphur mixtures as fungicides.—While Bordeaux mixture is the best fungicide known for all classes of fungus diseases growers have complained about the injury it does to foliage and fruit, especially of peach and plum. During the past few years experimenters have been trying to find a substitute, which will be as effective as Bordeaux without injuring the plants. The work of the U. S. Department of Agriculture and a few experiment stations seem to indicate that the Lime-sulphur mixtures fill these requirements.

Mr. W. M. Scott, of the U. S. Department of Agriculture, has been working with self-boiled lime-sulphur, and the results the past three seasons show that it is an effective fungicide for peach brown rot and peach scab. Other experimenters have had the same success with this mixture and also with the concentrated boiled washes, either home-made or commercial. Experiments carried on in Missouri and at Cornell show that the apple scab can be controlled with any of the lime-sulphur mixtures, without any injury to the foliage, but the boiled mixture is more effective than the self-boiled. At Cornell a commercial mixture was used, and the results would seem to indicate that it is effective.

While the lime-sulphur sprays have been used only a short time as a fungicide the writer believes that they should be used in prefer-

ence to Bordeaux because of the danger of injuring the fruit and foliage by Bordeaux.

Preparation of self-boiled lime-sulphur.

Flour of Sulphur.....	8 lbs.
Lime (unslaked).....	8 lbs.
Water	50 gallons

Mr. Scott has the following to say: "The mixture can best be prepared in rather large quantities,—say enough for 200 gallons at a time, making the formula 32 pounds of lime and 32 pounds of sulphur, to be cooked with a small quantity of water (8 or 10 gallons), and then diluted to 200 gallons.

The lime should be placed in a barrel and enough water poured on to almost cover it. As soon as the lime begins to slake the sulphur should be added after first running it through a seive to break up the lumps. The mixture should be constantly stirred and more water added as needed to form a thick paste at first and then gradually a thin paste. The lime will supply enough heat to boil the mixture several minutes. As soon as it is well slaked, water should be added to cool the mixture and prevent further cooking. It is then ready to be strained into the spray tank, diluted, and applied." See bulletin 174 of Bureau of Plant Industry, U. S. Department of Agriculture.

Concentrated lime-sulphur (boiled).

Flour of sulphur.....	16 lbs.
Lime (unslaked).....	20 lbs.
Water	50 gallons

Mix the sulphur into a thin paste. Slake the lime in from 5 to 10 gallons of water. If the lime is good it will boil violently and the sulphur paste may be added to take advantage of the heat from the lime. After the sulphur is added dilute to 20 or 25 gallons and boil for 45 minutes or longer or until it becomes a clear amber color. The mixture may be cooked in a large kettle over a fire or by using steam pipes in a barrel or tank. For treatment of scale insects in winter dilute to 50 gallons and apply while hot. For treatment of diseases when the trees are growing dilute this to 200 gallons. This point cannot be urged too strongly for if the concentrated mixture was used in summer it would kill the trees.

Commercial lime-sulphur.—There are a number of commercial mixtures which have given satisfactory results and when only a few trees are to be treated the grower would be justified in using them

instead of home-made preparations. They are more expensive but they are ready to apply as soon as diluted with the proper amount of water. Among the brands that have given good results are "Orchard Brand" lime-sulphur, "Rex" lime-sulphur and "sulfocide."

Combined fungicide and insecticide.—By using a poison with the fungicides, insects can be controlled at the same time that the plants are treated for diseases. In the combined treatments recommended for the various crops both insects and diseases are considered and the treatment suggested will control both if properly applied.

Bordeaux and Paris Green for Irish potatoes.

Paris Green.....	8 ozs.
Bordeaux	50 gallons

Bordeaux and arsenate of lead.

Arsenate of lead.....	2-3 lbs.
Bordeaux	50 gallons

For peach.

Arsenate of lead.....	1½-2 lbs.
Bordeaux	50 gallons

The Paris green should be thoroughly mixed with a small amount of water before put in the mixture. Make the arsenate of lead into a thin paste and pour into the spray tank.



Fig. 4.—Bitter Rot of Apple. Spray with Bordeaux mixture late in the season. (Va. Expt. Sta.)

DISEASES OF THE APPLE.

Bitter rot.—This disease known as bitter rot or ripe rot, is a disease of the ripening fruit and in another form produces a canker on the limbs of the tree. On the fruit the rot produces at first a slight discoloration and this increases until it becomes sunken, and on the

surface of the diseased portion are rough postules. This disease usually appears when the apples are about half grown and forms rotten spots on the surface which narrow in toward the core in the shape of a cone. It is supposed that the disease passes through the winter on the dried mummy fruits and on cankered limbs. See Fig. IV.

Treatment.—Remove all mummy fruit and cankered limbs and spray with Bordeaux as soon as it appears and continue at intervals of about two weeks until the fruit begins to ripen, then use ammonium copper carbonate solution if the disease persists.

Apple scab.—This is one of the most common and destructive diseases of apples and pears. It appears on the leaves and fruit early in the season as blotches. Fruit attacked early usually falls prematurely. On matured fruit it forms scabby blotches and injures the appearance of the fruit. It lives over winter on dead leaves, and these should be destroyed or plowed under. Spraying with Bordeaux mixture will keep this in check if applied at the proper time. Spray before the buds open with the copper sulphate solution and spray with the Bordeaux at intervals of ten days or two weeks. These later sprayings may also be made for insects and other diseases by using Bordeaux and arsenate of lead.



Fig. 5.—“Cedar Apple,” the winter stage of Apple Rust on common red cedar. Remove all cedars from vicinity of orchard. (Va. Expt. Sta.)

Apple rust.—This disease is very peculiar in having two host plants the apple and the common red cedar, and forms the well known “cedar balls” or “cedar apples.” The winter stage is on the cedar and in the spring on the approach of warm weather the spores ripen on the horns of the cedar apple and are carried by wind to the apple tree. When they fall on an apple leaf, they germinate and form yellowish spots on the under side of the leaf and in severe cases the foliage turns yellow and drops prematurely and this prevents proper development of the fruit. See Figs. V and VI.

Remove all cedar trees near the orchard or pick off and destroy the cedar apples. Spray with Bordeaux mixture about the time that

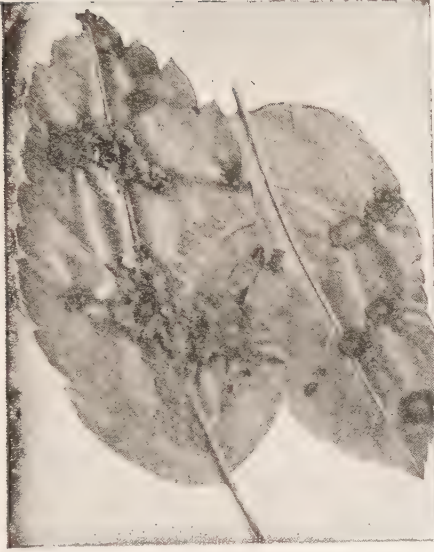


Fig. 6.—Apple Rust or Orange Rust of Apple, showing summer stage on apple leaves. (Va. Expt. Sta.)

the cedar balls become gelatinous, which is the time that the spores are ripening.

Brown rot.—This disease usually starts in a decayed place near the stem end, but sometimes near the blossom end of the fruit. This decayed area turns black and the fruit finally shrivels up and becomes a “mummy.” It also affects the leaves and appears as irregular brownish spots and causes cankers on the branches and all such branches should be removed and burned. Spraying with Bordeaux as recommended for the apple scab and bitter rot will keep it in check. Decayed and

mummy fruits should be gathered and destroyed as they are sources of infection.

Pear blight or fire blight.—(See under Pear.)

Combined treatment for apple:

1. Spray with lime-sulphur during winter if scale insects are present.
2. Spray with copper sulphate solution before buds open if the lime-sulphur spray is not given.
3. Spray with Bordeaux and an arsenical after leaf buds are open but before flower buds appear.
4. Spray with Bordeaux and an arsenical after blossoms fall.
5. In about two weeks give another spraying with Bordeaux and an arsenical if necessary. Repeat if necessary.

If it is necessary to spray up until the fruit begins to ripen use ammonium copper carbonate solution.

CHERRY.

Black knot.—(See under Plum.)

Leaf spot.—This disease affects the cherry and plum and appears as purplish spots on the leaves. The diseased spot often falls

out giving the shot-hole effect and is sometimes called the "shot-hole disease." All the leaves may fall prematurely and this prevents proper development of the fruit of the plum.

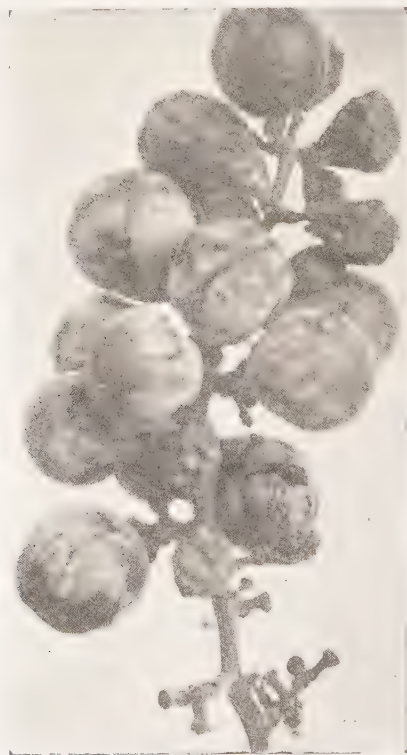
Spraying with Bordeaux will keep the disease in check. Make first application before the blossoms open, but after the leaves are out, and another application in about two weeks if necessary.

Brown rot.—(See Peach.)

Combined treatment for cherry.—(Same as for peach or plum.)

DISEASES OF THE GRAPE.

Black rot.—This is one of the most destructive disease of the grape and attacks all parts of the vine except the roots, but on the fruit it



does greatest injury. The first appearance is on the leaves and young shoots where it appears as brownish spots. The fruit may be attacked when half grown but the greatest destruction is following a warm, moist period just before ripening. The affected fruits first show dark spots which spread rapidly and may include the whole berry. The fruit dries up and usually remains on the vine, and these produce spores which remain dormant through the winter and serve as a source of infection in the spring. See Fig. VII.

The dried grapes and leaves should be gathered and burned or plowed under, and all prunings from the vine should be burned. Spray with Bordeaux just before the blossoms open and at intervals of two or three weeks until the fruit is about half grown then use ammonium copper carbonate.

Fig. 7. —Black Rot of Grape. Pick off and destroy mummy fruit and spray with Bordeaux. (Ta. Expt Sta.)

Downy mildew.—This is a common disease and chiefly affects the foliage, forming brownish spots above and whitish, downy spots on the under surface, from which it gets its name, "downy mildew." Young shoots and fruit may also be affected. The disease on the fruit produces brownish spots and is sometimes known as "brown rot."

The treatment for the black rot will keep the downy mildew in check. Collect and burn leaves where the disease is found in the vineyard.

Powdery mildew.—This disease is not likely to be so troublesome as either the black rot or the downy mildew. It forms mouldy or powdery growths on the upper surface of the leaf and can be distinguished from the above in this way. Late in the season black fruiting bodies are found on the surface of the leaf.

Spray as for black rot with one additional application with Bordeaux after fruit is gathered to kill the winter spores.

Combined treatment for grape:

1. Spray with copper sulphate solution while dormant.
2. Spray with Bordeaux mixture and arsenate of lead or Paris Green before the blossoms open.
3. Spray with Bordeaux after fruit has set.
4. Repeat at intervals of two weeks until fruit is half grown, then use ammonium copper carbonate.

PEACH.

Brown rot.—The brown rot is the most destructive disease of the peach in this section of the country. It affects the peach, plum, and

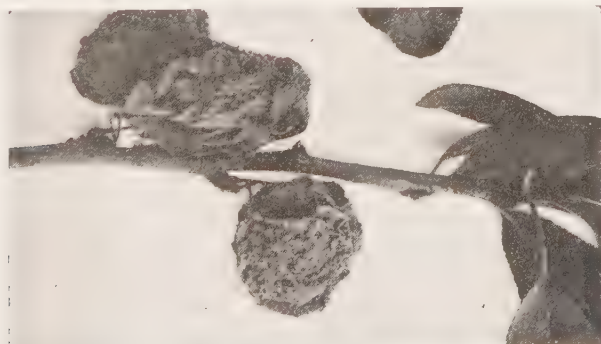


Fig. 8.—Brown Rot of Peach. The disease lives over winter in these mummies. Pick and destroy these and spray with Bordeaux³ or self boiled lime-sulphur. (Va. Expt. Sta.)

cherry, and causes great losses. It is estimated that the loss in the state of Georgia in 1900 from this disease was 40% of the crop or the loss of over half a million dollars. It thrives best in warm, moist weather and under favorable conditions may affect the flowers. The disease may affect the twigs and is often referred to as "twig blight." On the fruit the disease forms small brown spots and the fruit either falls to the ground or remains on the tree as "mummy peaches". (See Fig. VII), so commonly seen in the winter. These form centers of infection in the spring. Fruit should be thinned so they do not touch.

Gathering all diseased peaches and destroying them and spraying with Bordeaux and arsenate of lead will keep this disease in check. It has been observed that it is practically impossible to completely control brown rot with fungicides alone, but by getting rid of plum curculio by spraying with arsenate of lead the disease is not serious. The puncture made by the plum curculio gives chance for the brown rot spores to enter. Experiments carried on by Prof. Taylor of the Missouri Fruit Station show that spraying thoroughly with arsenate of lead for the curculio practically controls the brown rot, but the writer advises the use of either Bordeaux or self-boiled lime sulphur along with the arsenate of lead.

Spray:

1. Just after the blossoms fall with arsenate of lead.
2. About two weeks later with Bordeaux and arsenate of lead.
3. Apply Bordeaux at intervals of ten days or two weeks until the fruit begins to color. Self-boiled lime-sulphur might be used instead of Bordeaux.

Crown gall.—This is a disease of trees in the nursery row. It forms knotty galls on the lower part of the trunk and roots and is usually very easy to detect and trees affected with this disease should never be planted.

There is no safe remedy, but all trees affected should be burned, for if they are allowed to grow they will be a source of infection and never will be thrifty trees. This disease affects most all of our fruit trees, but seems to be worse on the peach than any other tree.

Leaf curl.—This disease is very wide spread, being found practically everywhere the peach is grown and the loss for this disease has been estimated to be as high as \$3,000,000 in a single year. It appears as soon as the buds begin to open and shows a characteristic curling of the leaves and deeper green color. (Fig. IX.) The twigs are also affected and become swollen and have a lighter color. The fungus lives

from year to year in the twigs and the infection in the spring is probably from them.

Spraying as for the brown rot will keep this in check. The self-boiled lime-sulphur wash is said to be especially valuable for this disease.



Fig. 9.—Peach Leaf Curl. Winter spraying with lime-sulphur for San José scale checks this disease. (Va. Expt. Sta.)

Trees sprayed for the San José scale need very little additional treatment for the leaf curl.

Rosette.—This disease is not known to affect the peach in Mississippi but in Georgia has attracted considerable attention. It appears as compact tufts or rosettes. The cause of the disease is unknown and there is no remedy except to dig up and destroy the tree.

Yellows.—The yellows, like the rosette, is not known to be present in this state, but is a serious disease of the peaches in most peach growing districts. It is the most destructive disease of the peach where it is present. The cause is unknown and there is no remedy except to dig up and destroy the infected trees. It appears as a yellow discoloration on the leaves and causes premature ripening of the fruit and the death of the tree.

Combined treatment:

1. Spray with lime-sulphur if San José scale is present.
2. If lime-sulphur is not used, spray with copper sulphate solution before buds open.
3. Spray with weak Bordeaux and an arsenical when fruit has set.
4. Repeat 3, 10-14 days later.
5. Repeat 3 about one month before fruit ripens.

Ordinarily where San José scale is not present three or four sprayings will be sufficient.

PEAR.

Pear blight, twig blight, or fire blight. This is the most serious pest of the pear and affects the apple also, and is the cause of the great loss of pear trees in this state. This is a bacterial disease which is supposed to be carried by insects from infected trees to those not affected. It usually starts at the tips of the branches and causes the leavaes and twigs to die, —giving the appearance of being scorched, hence the name, “fire blight.” Some varieties of pears are somewhat blight resistant while most varieties succumb in this section. The Keiffer is about the only variety that can be grown in Mississippi because of this disease.

Treatment. —This disease cannot be controlled by spraying as the bacteria or “germs” are within the tissue or the sap. It can be held in check by judicious pruning. Since it enters through the blossoms, all the fruit spurs should be removed from the large branches and main trunk as they would be as likely to be affected as the smaller branches if the spurs remained. The blighted portions of the branches should be removed and the cut should be made 8-12 inches back of the dead portion and the pruning shears should be disinfected by passing through flame or a solution of carbolic acid to prevent carrying the bacteria to uninfected plants. The prunings should be gathered and burned. The blight develops most rapidly on fast growing trees so they should not be heavily fertilized, especially with nitrogenous fertilizers. Pruning off all fruit spurs on the main branches will prevent the disease from entering them and this is essential because they cannot be removed without severely injuring the trees.

Pear scab.—The pear scab is very similar to the apple scab and is kept in check by the same treatment. (See under Apple.)

Leaf blight.—This disease must not be confused with pear blight or twig blight for it is a very different disease, —being caused by a fungus growth. It causes a premature discoloration of the leaves and frequently causes the fruit to crack. On the leaf the diseases appears as small reddish spots and these may unite and extend over the whole leaf and may cause them to fall prematurely. It sometimes affects the twigs, forming a sunken spot on the bark.

Fallen leaves should be raked up and burned.

Bordeaux mixture will keep the disease in check if applied at the proper time. The application should be made as follows:

1. When the leaves are about half grown.
2. At intervals of two weeks until three additional sprayings are given, using ammonium copper carbonate at the last spraying to prevent discoloration of the fruit.

Combined treatment for the pear:

1. Spray with lime-sulphur wash in winter if San José scale is present.
2. If spraying No. 1 is not given, spray with copper sulphate solution before the buds open.
3. Bordeaux and an arsenical just before the blossoms open.
4. Bordeaux and an arsenical within a week after the blossoms drop.
5. Repeat in ten days or two weeks.
6. Spray with Bordeaux alone at intervals of two weeks if necessary to check scab and leaf blight until fruit begins to ripen, then use ammonium copper carbonate.

PLUMS.

Black knot.—This disease is one of the most serious of cherries and plums. It forms the rough, wartlike, knotty growth on the branches. See Fig. X. The first appearance is on the young growth as irregular, knotty swellings, which possess at first a dark olive color

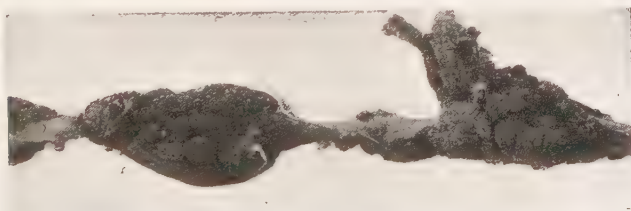


Fig. 10.—Black Knot of Plum and Cherry. Remove and burn diseased branches and spray with Bordeaux or self-boiled lime sulphur. (Va. Expt. Sta.)

due to the number of spore-bearing stalks which grow out on the surface. These spores are scattered by the wind and rain and affect other branches. The fungus starts in the spring from the winter spores which live over in the knots.

Treatment.—All twigs should be removed after the leaves fall to prevent the production of winter spores and all knots formed during the summer should be removed. If these knotty branches are cut off

and allowed to remain on the ground the spores may ripen and spread the disease. They should be burned immediately after being removed.

Canker.—This is a very serious disease in some sections of the south, and is probably found in this state. It usually follows a wound or attack of brown rot or gummosis. The disease appears on the branches as cankered spots and the fungus works in the tissue.

The best treatment is to spray thoroughly for brown rot and plum pockets, and avoid injuring the tree. Remove and burn cankered branches. •

Plum pockets.—This is a rather peculiar disease living over winter in the twigs and growing out into the ovary in the spring causing a distorted growth. The plum is usually considerably swollen and distorted and often forms a sort of pocket on one side. No seed is produced in the plum affected by plum pocket. It also affects the leaves and twigs. No remedy has been found very satisfactory, but Bordeaux mixture would probably reduce the amount of the disease. All diseased fruit, twigs and leaves should be removed and burned.

Brown rot.—(See Peach.)

Crown gall.—(See Peach.)

Combined spraying for plum:

1. Spray with lime-sulphur before buds open if infested with San Jose scale.

2. If lime sulphur is not used, apply copper sulphate solution just before buds open.

3. Just after blossoms fall, apply Bordeaux and arsenate of lead,—weak formula. Repeat in ten days or two weeks.

4. Apply Bordeaux at intervals of two weeks, if necessary, for brown rot.

Self-boiled lime-sulphur wash may be substituted for Bordeaux.

DISEASES OF STRAWBERRY.

Leaf spot.—This is the most serious disease of the strawberry. It appears as small purplish spots on the leaves and these increase in size and the center of the spot turns to a bright reddish brown color. The leaves usually die, and in the autumn give rise to resting spores which carry the disease through the winter. In the spring these spores become active and start the disease.

None but healthy plants should be set out and the disease-infested patch should be burned over to prevent infection of new plantings.

Spray newly set plants or bearing patch with Bordeaux when new foliage appears and again after the fruit is picked. Mowing and burning the leaves after the fruit has been gathered has been found to reduce the disease.

DISEASES OF VEGETABLES.

ASPARAGUS.

Asparagus rust.—This disease is very similar to the rust of grains. It produces reddish or black spots on the plants and often causes considerable damage. Cut out and burn all infected plants, and after the cutting season spray with Bordeaux. Cut down and burn all the plants in the fall. Fertilize and keep the plants in a healthy growing condition.

BEAN.

Anthracnose or "pod spot."—This is the the most serious enemy of the bean and can be found in most any patch of beans. It affects the leaves, stems, and pods, but is most noticeable on the pods where it forms brown, sunken areas which turn darker with age and have reddish margins. See Fig. XI. On the leaves, it affects the veins, producing spots similar to those on the pods. The mycelium often enters the seed of the bean and may remain dormant for a long time if the beans are kept dry, then when they are planted the mycelium will grow and produce spores which will affect other plants. The spores are held together by a gelatinous substance which is readily dissolved by moisture, therefore, are readily distributed after a rain or heavy dew.

Methods of control.—Since this disease lives over winter in the seed, such seed should not be planted. Seed from an infected fields should not be used if others can be secured; if not, select pods which have no disease. Do not cultivate or enter the patch for any purpose while the plants are moist for the spores are readily distributed then. They adhere to the clothing and may be carried to uninfected plants by this means or by cultivating implements. It is recommended that the farmers and gardeners in Mississippi grow their own seed by planting in the fall for seed to plant in the spring.

Bordeaux mixture, if thoroughly and properly applied, will undoubtedly aid in keeping the disease in check, but must not be relied upon entirely. Affected plants, especially when very young, should be pulled up and burned to prevent spread of the disease.



Fig. 11.—Bean Anthracnose. Do not cultivate while vines are wet; use clean seed and spray with Bordeaux. (W. Va. Expt. Sta.)

Bacterial blight or bacteriosis.—This is a bacterial disease which attacks both lima beans and common garden beans. The disease appears on the leaves as small yellowish spots which increase in size and gradually turn brown in the center of the spot. Affected leaves remain on stalk until completely dead and then the ends of the petioles become affected and often extends back into the branches of the plant and to other leaves and pods. This disease need not be confused with the anthracnose because the diseased areas are not sunken in bacteriosis.

Treatment.—The disease is caused by bacteria which live over winter in the dead leaves and vines. These should be burned where

disease is present. Insects spread the disease so efforts should be made to keep them in check and thus prevent the spread to uninfected plants.

CABBAGE, CAULIFLOWER AND COLLARDS.

Club root. -This is about the only serious disease of these plants. It is caused by a species of slime mould which produces knot-like



Fig. 12.—Club Root of cabbage and related plants.
}Due to growth of a slime mold. Lime land and
rotate crops. V(a. Expt. Sta.)

growths on the roots. The disease germs often become established in the soil where they will live for a time, but will eventually die if no plants are present upon which to feed. Rotation of crops is one of the best remedies. Never set out plants in soil infested with this disease and not use plants from an infested bed. Pull up and destroy diseased plants. Lime applied at the rate of about 80 bushels to the acre will aid in keeping this disease in check.

CELERY.

Leaf-blight and leaf spot.—These two diseases are quite similar and will be treated together. They produce rusty, brown, irregular spots on the leaves and often cause considerable damage to the celery crop. The foliage turns yellow and finally dies. Spraying with Bordeaux mixture will keep these diseases in check and the application should be made while the plants are in the seed bed and kept up at intervals until the celery is banked.

Damping off.—This disease is caused by a fungus growth which attacks the young plants in the seed bed. It affects all kinds of young plants and is the most serious disease of the seed or cutting bed. It forms a web like growth over the plants in severe cases and the plants rot off just at the surface of the ground. It is promoted by the excessive heat and too much water or insufficient air and light and by the presence of organic matter in the soil. Remove affected plants and withhold water especially on cloudy days. Thin plants so they will not mat together and give plenty of air and light.

CORN.

Smut.—The black-sooty growth appearing on the ears is caused by this disease. The black powdery mass which flies out when the stalk is jarred is the spores. If only a small area of sweet corn is grown, the



Fig. 13.—Perfect fruit on a sprayed tree (pile on left) and on an unsprayed (pile on right), both young trees. Results of a single spraying with arsenate of lead for coddling moth. (Va. Expt. Sta.)

diseased plants should be removed before the spores are ripe. Avoid planting on land heavily manured and select varieties which are somewhat resistant.

CUCUMBER.

Downy mildew.—This is the most destructive disease of cucumbers and melons but is especially injurious to the cucumber. The first appearance in the fields is the yellowing of the leaves in the center of the plant, then spots begin near the veins. The disease spreads rapidly from the center outward to the tips in warm moist weather and the leaves appear as if scorched. This is also very destructive to cucumbers in the greenhouse.

The disease is caused by a fungus closely allied to the downy mildew of grapes and other plants. So far as known there are no resting spores which carry the disease over winter, but the disease may spread from the field to the green house and back to the field again in the spring. It lives through the winter in the south and probably gradually imigrates north in summer, reaching New York in August. Any check to the growth is favorable to the attacks of the downy mildew so that liberal fertilizing and thorough cultivation will aid in keeping this in check.

Spraying with Bordeaux mixture has been found to be very effective. Make the first application as soon as the vines begin to run and spray at intervals of one to two weeks, the aim being to keep the vines thoroughly covered with the mixture.

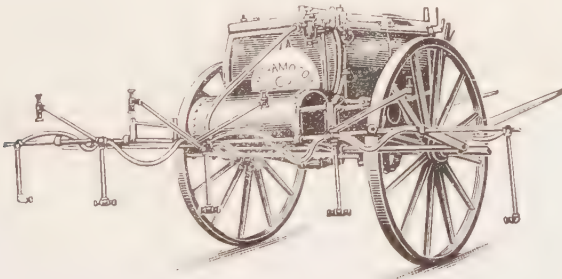


Fig. 14.—Geared compressed air sprayer for spraying potatoes and similar crops in rows. Air pump geared to axle of cart. (Sprimotor Co.)

Leaf blight.—This disease begins as small, roundish spots and soon the leaf curls up at the edge and dies in a few days. It is probable that the disease lives over winter in the old vines or in the soil as it is observed to be worse in the fields planted in melons or cucumbers year after year. The leaf blight hastens the maturity of the fruit and in

damp warm seasons, causes great injury. The past season the writer saw large fields in which the yield was diminished by half because of this disease. There were car loads of musk melons about half grown and the vines were completely dead.

Destruction of vines, rotation of crops and spraying as recommended for the downy mildew will keep the leaf blight in check and will give large returns for the work.

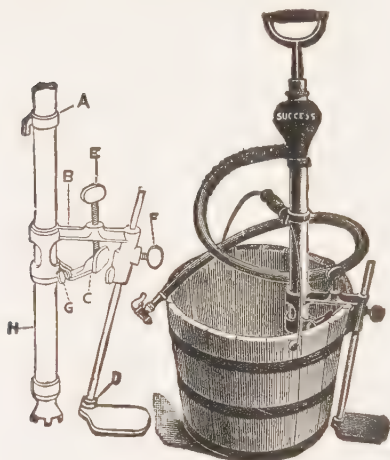


Fig. 15.—Bucket pump, a very simple pump for use only in a small garden. Costs about \$2.00. (Deming.)

Anthracoſe.—Anthracoſe is found on leaves and ſtems of cucumbers and muſk-melons, and on the leaves, ſtems, and fruit of water-melons. On the leaves it forms angular ſpots and on the ſtems and fruit it forms irregular ſunken areas. The common ſunken ſpots on the water melon is due to this diſeaſe. The fungus cauſing this diſeaſe is cloſely related to the fungi cauſing anthracnoſe of cotton, beans, bitter rot of apples, etc. It probaly lives over winter in the vines. Deſtroy vines and rotation of crops are recommended.

Spraying as recommended for the downy mildew will aid in keeping the anthracnoſe in check.

(See Farmers' Bulletin No. 231 for further diſcuſſion of the diſeaſes of cucumbers and melons.)

EGG PLANT.

(See Tomato.)

LETTUCE.

Lettuce grown out of doors in a good, well-drained location rarely ſuffers from diſeaſe. In the greenhouse, two or three diſeaſes are ſometimes troublesome.

“Damping off”.—A diſeaſe of ſeedling plants in which they rot off at or near the ſurface of the ground. (See under Celery.)

Downy mildew forms mouldy or downy growth on the leaves and gives them a froſted appearance. High temperature and too much moiſture are conditions favorable to this diſeaſe. Under glaſs have

good ventilation and do not keep the soil soaked. Plant in well drained soil out of doors.

Drop or rot.—This disease is sometimes quite serious, especially in the greenhouse, and is hard to control. The stems and leaves wilt and rot off at the surface of the soil, the whole plant dying. Care in watering and proper ventilation will keep this disease in check. Sterilizing the soil in greenhouses by passing live steam through it will prevent the drop.

MUSKMELON.

(See Cucumber.)

ONION.

Smut.—Smut is often a very destructive disease of the onion. It appears as black dusty powder on various parts of the plants, and is especially injurious to seedlings. The fungus lives over in the soil, hence rotation of crops is the best remedy, but if it is necessary to use infested soil, apply 100 pounds of sulphur and fifty pounds of air-slaked lime per acre. Sow with seed in drill.

POTATO (IRISH).

Early and late blight.—Both of these are quite common diseases throughout the south and often cause a great deal of damage. The leaves become black and usually a whitish growth of fungus forms on the under surface of the leaves. The late blight is responsible for the wet rots of the potatoes in bins in addition to the blighting of the foliage. When these diseases are frequent the potatoes should be sprayed with Bordeaux mixture every two or three weeks during the growing season and by adding Paris Green, the potato beetle can be combatted by the same application. Air-slaked lime sprinkled among the tubers in bins will check wet rot.

Scab.—This disease is quite generally found wherever the potato is grown in this country, and causes great losses. It appears on the tubers

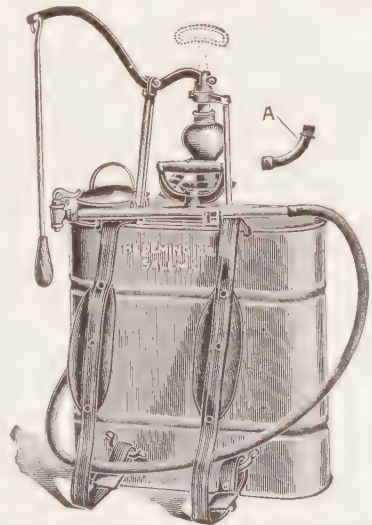


Fig. 16.—Knapsack, Sprayer, for use only in small garden. Too expensive for the work it can do cost, \$10 to \$12.00. (Deming.)

as rough, dark, scabby spots, which may be so numerous as to cover the whole tuber. The spots usually appear as sunken areas, which is probably due to the attempt of the tuber to withstand the attacks. The depth of the scabby spot depends upon the age of the tuber when attacked. If attacked when the tuber is nearly mature, the spots are quite superficial. The disease probably lives over in the soil, but is usually carried about on the tubers. Potatoes should not be planted in infected soil and infested or scabby tubers should not be used for seed. As a safeguard, treat the tubers with a solution of formalin. 1 pint of formalin (40% strength) to 30 gallons of water. Soak cut or uncut tubers for two hours in this solution and pour out to dry.

SQUASH.

(See Cucumber.)

SWEET POTATO.

There are several rots of the sweet potato, all affecting the tubers. Diseased roots should not be used for seed and care should be taken not to bruise the tubers when handling. Keep them in a dry place, where there is plenty of ventilation, with a temperature of fifty to sixty degrees. Gather and burn diseased potatoes and get plants free from disease.

TOMATO.

Wilt, blight (*Fusarium*).—This disease starts on the plants in the seed bed and spreads to the field. In the field, it begins on the lower leaves and spreads upwards. It produces small dark spots on the leaves and stems and in severe cases destroys the crop. It can be kept in check by spraying three or four times with Bordeaux mixture, beginning soon after transplanting.

Fruit rot or dry rot.—This disease causes the green fruit to rot at the blossom end and causes great damage to tomatoes, both in the field and in the green house. It is doubtful if spraying will be of any value as the disease is supposed to be a constitutional or physiological trouble. Pull up and burn all affected plants, and select disease resistant plants.

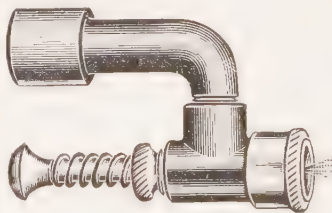


Fig. 17.—Single nozzle of Vermorel type, one of the best nozzles. (E. C. Brown Co.)

WATERMELON.

(See Cucumber.)

DISEASES OF FLOWERS.

The conditions prevailing in greenhouses are favorable to the development of many diseases. Proper attention to heating, watering, and ventilating will reduce these enemies to a minimum and in many

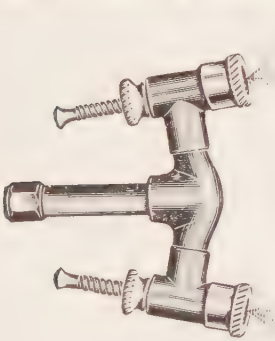


Fig. 18.—Two-point nozzle of Vermorel type, quite commonly used. (E. C. Brown & Co.)

cases will keep plants in a healthy condition. Many of the surface fungi can be kept in check by spraying the foliage with clear water or some prepared fungicide. In many cases it is best to destroy infected plants or parts of plants as soon as the disease appears. This prevents the spread of the disease to uninfected plants.

Sulphur is the best fungicide for greenhouse plants and can be used with very little trouble. The simplest method is to make up a paste with a little lime or other powder and water and smear on the heating pipes. When diseases cannot be kept in check by the above method apply a liquid fungicide, using some of the clear liquids as copper sulphate solution or ammonium copper carbonate to prevent coloring the foliage.

CARNATION.

Carnation Rust.—First noticed as a slight swelling on the stem or leaf and in the early stages the affected parts become almost colorless. As the fungus matures the spores become brownish and impart a brown color to the diseased parts. The rust attacks the carnation in every stage of development from cuttings in the propagating bed to the matured plants. High temperature and a close, damp atmosphere favor the development of the disease.

Take cuttings only from plants free from rust and guard against unfavorable conditions. A strong solution of copper sulphate solution will aid in keeping the rust in check.

Carnation Spot.—This disease is characterized by circular or oblong spots with a brownish center. On the stem the spot appears as an oblong spot on one side. Development is usually due to improper treatment of the plants as over watering, or by allowing the plants to remain

wet over night, especially where the temperature falls quite low. Under favorable conditions, the disease does not become serious. It can be kept in check by the same treatment as recommended for the rust.

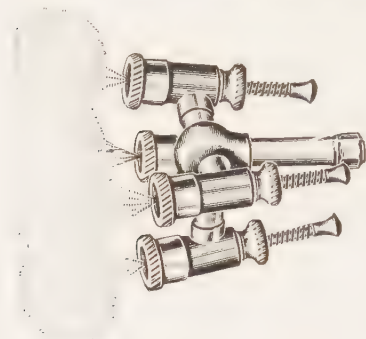


Fig. 19. — Four-point nozzle of Vermorel type. (E. C. Brown Co.)

Stem rot.—In some seasons this disease destroys nearly the whole crop of carnations of some growers. There are three kinds of stem rot of carnations: (1) Where the plant dies at the collar or surface of the ground and the entire plant is lost. (2) "Branch rot," where the branch is affected and only a part of the plant is destroyed. (3) Leaf rot, which seems unable to affect the uninjured leaf, but when there are rust spots it usually appears.

The spores live over in the soil. As a preventative measure always change the soil after growing a crop of carnations. Sterilize the beds and potting soil and avoid too much nitrogenous matter. Propagate only from strong vigorous plants.

CHRYSANTHEMUM.

Leaf spot.—There are several forms of leaf spot affecting the chrysanthemum. They appear as discolored dead spots on the leaves and are quite noticeable. Pick off and burn all affected leaves and spray with Bordeaux mixture as soon as disease appears and repeat if the disease persists. If it is necessary to spray after the flowers are open use copper sulphate solution or ammonium copper carbonate to prevent coloring the blossoms.

Rust.—Appears very much the same as the carnation rust, as rusty or reddish brown spots on the leaves. In propagation use only good healthy plants. Spray just before the appearance of the blossoms, with Bordeaux mixture and burn all discolored leaves.

ROSE.

Black spot.—Causes spots on leaves of tea and hybrid roses in wet seasons. The edges of the spots become fringed with white and later in the season turn yellow and fall.

Poorly drained or over-watered beds or a drop in the temperature is likely to cause the appearance of the disease. The disease can be kept in check by using Bordeaux mixture but it gives the foliage a

white-washed appearance, so a solution of copper carbonate is usually used. All affected parts should be removed and burned.

Mildew.—Appears as a mealy or powdery covering on the leaves of the roses and stunts the growth of the young shoots. The leaves are dwarfed and usually turn downward.

Under proper conditions the disease does not do much injury. The general treatment for greenhouse plants will usually be sufficient for the mildew.

Rose rust.—Appears as light yellow spots on both sides of the leaves and upon the stems. The spots are quite small but often run together and cover the leaf, destroying it.

The affected branch should be cut and burned to prevent the spread of the disease. Spraying with Bordeaux or other copper compounds will prevent the spread.

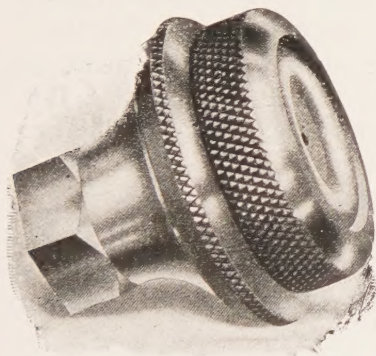


Fig. 20.— Automatic nozzle, one of the larger types of nozzles very satisfactory. Not easily clogged. (E. C. Brown Co.)

Anthracnose.—This disease affects the tender canes and often girdles the plant, thus cutting off circulation. The disease spreads toward the tips and under favorable conditions spreads very rapidly.

Affected parts should be cut and burned as soon as noticed. Thorough spraying with Bordeaux before the spores germinate is a sure method of preventing the spread. Avoid poorly drained or exhausted soils as these are conditions favorable to the development of the anthracnose.

VIOLET.

Spot disease.—This is the most serious disease of the violet and is often referred to as the "violet disease." It is found wherever the violet is grown and the first faint indication of its presence is a very faint odor noticed by the expert violet grower. It forms greenish water spots on the leaves and in these spots spores are formed.

Every spot should be removed and burned and if the leaf has several spots it is best to remove and burn the whole leaf. As yet no fungicide has been found that will be of much value in keeping the disease in check. Keep the house clean and have the very best conditions for growth,—never allowing water to remain on the leaves

very many hours. Over-feeding and fumigation with tobacco smoke weakens the plant, thus making it more susceptible to the spot.

Wilt or stem rot.—This disease is next to spot in importance. It is usually confined to the stems but sometimes affects the leaf. The first indications of the disease is a wilting during the day and reviving at night. On examination the plant will usually be found to be girdled by the fungus and the circulation thus cut off.

Pulling off the leaves gives a good chance for the spores to enter and the method of propagation by dividing the crown carries the disease over from year to year. Continuous use of the same soil also aids in the propagation of the disease.

Manufacturers and dealers in spraying machinery and appliances.—E. C. Brown & Co., Rochester, N. Y.; The Deming Co., Salem, Ohio; The Goulds Mfg. Co., Seneca Falls, N. Y.; Spramotor Co., Buffalo, N. Y.; Friend Mfg. Co., Gasport, N. Y.; Cushman Power Sprayer, Lincoln, Neb.; Olds Gas Power Co., Lansing, Mich.; W. & B. Douglas, Middleton, Conn.; Hardie Mfg. Co., Hudson, Mich.; Deyo & Co., Binghampton, N. Y.; Wm. Stahl Sprayer Co., Quincey, Ill.; F. E. Meyers & Bro., Ashland, Ohio; Moril and Morley, Benton Harbor, Mich.; Field Force Pump Co., Elmira, N. Y.

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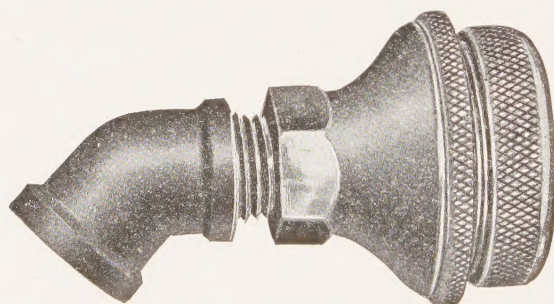


Fig. 21.—Nozzle with 45 degree attachment to extension rod. With this attachment the spray can be directed downward into the tree. A useful device. (E. C. Brown Co.)

The cuts illustrating spray nozzles and appliances were loaned by E. C. Brown Co., of Rochester, N. Y., the power sprayer is from a photograph by Friend Mfg. Co. All of the cuts showing disease injury to fruit are from plates loaned by the Virginia Experiment Station; the cut of bean an-

thrachnose was loaned by the West Virginia Experiment Station. The author wishes to express his appreciation of the courtesy shown by the gentlemen who were responsible for loaning these illustrations.

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